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Industrial HEALTH REVIEW

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Industrial Health Services
IN CIVIL DEFENCE

ONE of the main objectives of an enemy will be to disrupt industry and it will be one of the chief functions of civil defence to prevent this as much as possible while maintaining wartime production at a high level. Industrial health services are strategically situated to make a major contribution in this respect by ensuring that workers remain healthy and on the job, or are quickly rehabilitated.

Industrial health services in plants, along with similar official agencies at provincial and federal levels, should work closely with the appropriate civil defence authorities. This cooperative program is essential if industry is to make a major contribution to civil defence and civil defence is to provide the best possible service to industry.

There are a few examples of large industrial units in Canada with completely equipped and fully staffed industrial medical services. However, as many of our industries employ less than 500 persons, the industrial medical services provided for such units include only full-time or part-time nursing personnel and in certain cases a part-time physician who provides medical supervision. Many industries, however, do not have any industrial medical services. It is highly recommended that industrial plants currently without health services begin immediately to provide these services both for the purpose of general war mobilization and for disaster preparedness. A reasonable health service, particularly in plants engaged in defence production, should be considered a civil defence requirement. Official industrial health agencies in Canada should be prepared to act in an advisory capacity and to encourage an adequate industrial medical service in a greater number of plants.

Participation in Civil Defence Casualty Service Arrangements

Where in-plant services exist, they will form a valuable nucleus around which civil defence casualty service units can be built. The extension of the plant medical arrangements can be accomplished by the training of employees in first aid, stretcher and rescue work and ambulance organization. This additional group should be trained not only to deal with disasters which might affect the plant but should also be coordinated into the overall community civil defence program. Furthermore, in consultation with the local civil defence health service director, it may be considered practical to allocate professional personnel to augment in-plant services during the disaster period. The aim should be to utilize fully the experience of industrial medical personnel in handling industrial emergencies. This experience should play a maximum role in the civil defence service arrangements.

It must be remembered that a basic concept in civil defence casualty planning is to provide services which are flexible and mobile. The plant medical service should be organized to function as a casualty unit within the plant and also as a mobile unit which might be moved to a more strategic location if the disaster is some distance away. The reader is referred to Sections A to G of the Civil Defence Health Services Manual for general information and details of casualty service organization.

As soon as possible after an emergency, the industrial medical service should be re-established in industry. However, in order to provide continuing service to civil defence, it should function as an outpatient unit and relieve congested hospitals of much of this responsibility.

Control of Toxic and Dangerous Industrial Chemicals in Industry

Modern industry uses many chemicals which are highly toxic but are employed with safety in peacetime because of adequate control. Certain industrial chemicals are also highly inflammable or liable to explode. In a wartime disaster these materials might become widely dispersed and produce additional casualties and panic. This could interfere with fire fighting, rescue and casualty service arrangements. Furthermore, the blast might disrupt control measures in plants near the fringe of the disaster area and create a continuing hazard for employees on the job.

Civil defence authorities should know these danger spots in industry and keep an inventory of location and methods of control. They should be advised on how to prevent or limit such an occurrence by an advisory committee composed of personnel familiar with local industry and the associated health hazards.

Where in-plant services exist, the medical department should consult with safety engineers and obtain a complete picture of the situation in that particular plant. However, as many of our industries do not have a medical service, official industrial health agencies should be prepared to assist with this program, particularly in potential target areas. These agencies will have considerable information on hand, obtained from plant visits and studies, but in certain cases additional surveys will be required. When this is necessary, the

technique used for a preliminary industrial hygiene survey, with modifications to suit local conditions, will provide a rapid means of obtaining the overall picture. A more detailed study can then be made of potential danger points.

Civil defence authorities should have all of these data assembled and on file. They should inform firefighters, rescue and casualty personnel where hazards are likely to occur and the measures recommended to minimize the danger. If special protective equipment is necessary, it should be stored in an easily accessible spot and personnel trained in its use. Local public health authorities should be alerted when industrial materials are likely to cause any public health problems in the community such as the contamination of water supplies or dangerous situations in neighboring built-up areas. If the water supply of communities downstream is in danger, they should be promptly warned.

Morbidity Records in Industry and their Value in Biological Warfare Defence

Accurate disease reporting from a variety of sources will provide valuable information for the early detection of illness which may be caused by biological warfare agents. This information should be obtained from every available reliable source as it is a necessary procedure to provide effective treatment and to limit the extent of damage to the populace. Records of absenteeism in industry, particularly if they are interpreted by informed industrial medical personnel, can make a major contribution to this detection system and should be integrated into this part of the civil defence program.

Industrial Health Units as a Source of Reliable Information on Civil Defence Health Problems

Workers have become accustomed to referring their health problems to the physician and nurse in industry and it will be from the industrial physician and nurse that they will want advice on health matters pertaining to modern warfare. These problems can be put into proper focus. Exaggerated concepts, which are frequently the result of lack of knowledge or distortion of fact, can be avoided.

Other Areas in Which Industrial Health Can Contribute to Civil Defence

Industrial health activities cover a wide field and personnel come from many professions. The knowledge and facilities available in this specialty should be carefully studied to provide the greatest possible assistance to civil defence. For example, health radiation sections have the basic training required for supervisory personnel in radiological defence units; air sampling methods used by industrial hygienists may be used for the early detection of biological and chemical warfare agents and respirator testing equipment will be of value in testing war respirators. Similarly, industrial hygiene chemists have in many cases had experience with chemicals closely allied to war gases and can be of value in chemical warfare defence. These and other examples indicate that industrial health "know how" and facilities should be carefully assessed and thoroughly integrated into civil defence planning.

Industrial Hygiene Survey
OF THE PRINTING INDUSTRY IN HALIFAX

By C. R. Ross
Industrial Hygiene Engineer
Nova Scotia Department of Public Health

The printing industry in Halifax consists of eighteen plants which range in size from as few as three to more than one hundred shop employees. The total number of shop employees in all plants is approximately three hundred and fifty. Most of the smaller plants engage almost exclusively in job printing, while larger plants are devoted to newspaper production, photo-engraving and lithographing. All plants were examined for potential health hazards and the extent of exposure to toxic substances was determined by air, urine and material analysis.

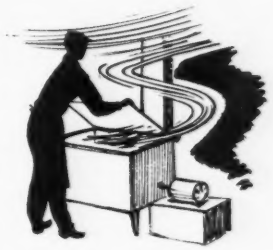
Lead, carbon monoxide, benzol and nitrogen oxides were the principle harmful air contaminants encountered. Many workers were found to have contact with dermatitis-producing agents such as chromates, dyes and solvents. Enquiries did not reveal any cases of illness attributed to occupation in any of these plants in recent years.

Lead-in-air concentrations were measured in all workrooms of a newspaper plant where lead was handled, and also in one job-printing shop. Concentrations of lead significantly in excess of the threshold limits were found only during the remelting of scrap lead.

Fifty urine samples from lead-exposed workers were tested. The mean lead content of these samples was 0.101 milligrams per litre. Six samples contained lead in excess 0.15 milligrams per litre and three samples had a lead content in excess of 0.20 milligrams per litre. Porphyrin tests were made on thirty-eight of

these samples and seventy-five per cent of these tests were negative. Results were taken to indicate a mild exposure to lead. It was recommended, however, that workers in stereo and remelt rooms, together with those having other contact with lead—as in the handling of dross, have periodic urine lead examination as a precaution against lead absorption. The possibility of lead poisoning occuring among other employees such as linotype operators or compositors appeared remote.

Gas-fired apparatus was found to be used extensively in most plants and presented a hazard, particularly where such apparatus was used in small rooms without adequate ventilation. Air tests were made for carbon monoxide wherever there appeared to be a possibility of significant concentration of this gas. The principle source of carbon monoxide was found to be unvented gas-fired monotype casting machines. Recommendations were made to some plants respecting local exhaust ventilation of these machines.



Solvents containing benzol were found to be in common use as type cleaners. Exposure to such solvents was quite intermittent and no attempt was made to measure air concentrations. Less toxic substitutes were recommended. Solvent compositions were checked with manufacturers and one maunfacturer agreed to try substitution of less toxic solvents for benzol in the solvent preparations which he supplied to the printing industry.

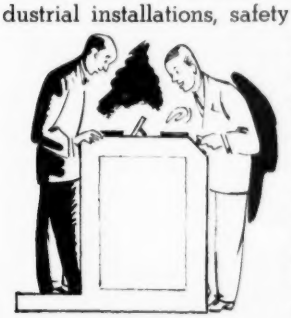
Nitrogen oxide concentrations were determined in etching rooms and in the vicinity of arc lamps in photoengraving plants. Exposures did not appear serious during the normal course of operations but there was a possibility of excessive concentrations at times because of poor ventilation systems. Etching machines have exhaust fans built into the machines. Exhaust from these machines was escaping through adjacent equipment rather than being vented into the atmosphere. Recommendations were made for improved systems.

The Assessment of Radiation Hazards

From Fluoroscopic X-ray Machines for Shoe Fitting

By C. Garrett
Radiology Laboratory, Division of Physics
National Research Council of Canada

Any x-ray machine, unless properly constructed and controlled, may become a health hazard to all people near it. The exposure of persons to the direct x-ray beam, to the scattered radiation from objects in the room and to the stray radiation from the x-ray tube may result in serious consequences unless special precautions are taken. These hazards are well known among x-ray personnel and hence, in medical or industrial installations, safety devices such as lead-lined protective tube heads to stop stray radiation from the x-ray tube, lead-lined x-ray rooms and control booths and special timing devices, are provided to protect the technicians and other personnel who are required to be near the x-ray machine when it is on. Fluoroscopic shoe-fitting machines are a special type of x-ray machine; unless similar precautions are taken these machines can be a health hazard to shoe salesmen, to clerks and to customers.



This report discusses the hazards peculiar to the shoe-fitting fluoroscopic x-ray machine and gives methods of assessing these hazards.

Measurement of these radiation hazards should be undertaken only by physicists who have had experience in the measurement of x-rays and who have available the appropriate instruments.

GENERAL DESCRIPTION OF SHOE-FITTING FLUOROSCOPIC X-RAY MACHINES

The essential components of the shoe-fitting x-ray machine are the x-ray tube, the transformer, the fluorescent screen, the timing mechanism, the starting mechanism and the cabinet in which these compenents are housed.

The x-ray tube is mounted in the bottom of the unit with the x-ray beam directed upwards. Above this tube, at a distance not usually greater than eight

inches, or less than three inches from the x-ray target, is a platform on which the feet are placed. Above the opening in the side of the cabinet through which the feet may by placed on the platform is located the fluorescent screen. The image on the fluorescent screen is viewed through windows at the top of the cabinet.

The timing mechanism is a device to limit the exposure to some predetermined time such as five or ten seconds.

Under the foot pedal there is often a micro-switch which serves as a safety device to prevent the operation of the machine until the feet are placed on the platform.

The arrangement of the essential components in the shoe-fitting fluoroscopic machine is shown in Figure 1.

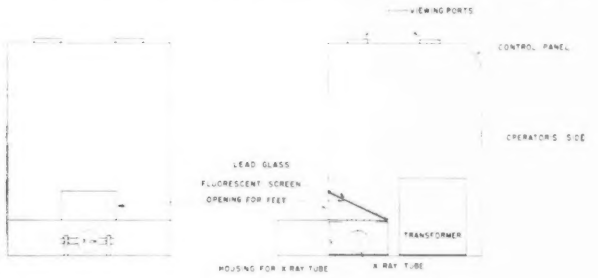


FIGURE 1

The x-ray tube is enclosed, either wholly or partially, within a steel cabinet or a wooden, lead-lined box. A large opening in the top of this box allows a beam of radiation to strike the foot platform.

Some very old machines may have no tube enclosure other than a lead-rubber jacket around the central or spherical part of the x-ray tube. In some units the x-ray tube is surrounded by oil for cooling purposes while in others it is air-cooled.

The x-ray tube is usually operated at about 50 kilo-volts with a tube current of from one to seven milliamperes.

On many machines the transformer is placed adjacent to the tube enclosure and constitutes the enclosure wall on that side.

HAZARDS

(1) *Direct Radiation*—When the feet are placed on the foot pedal of the x-ray machine they are in the direct beam of the x-ray tube. Unless care is taken in the operation of the machine to insure that the exposure time is short, that the number of exposures per person is limited and that tube ratings (current and kilovoltage) are correct, there is the possibility of injury to the customer's feet through excessive exposure to the primary beam. The American Standards Association has made the following recommendations: (1) that the exposure to the foot shall not exceed 2 r per examination; that the installation shall be posted with a warning sign saying that repeated exposure to x-rays may be harmful and that fluoroscopic examinations for shoe-fitting should be limited to not more than 12 in one year.

(2) *Stray Radiation*—In all x-ray tubes radiation is emitted from the tube in directions other than that of the main x-ray beam. This radiation is known as stray radiation. Unless the stray radiation is controlled, all persons in the area of the machine, namely clerks and customers, will be subjected to this stray radiation.

This stray radiation may be eliminated by enclosing the tube in a lead-lined housing of a design and thickness such that only the direct beam is emitted.

(3) *Scattered Radiation*—When x-rays pass through a body such as the foot which is being viewed in a shoe machine, a small amount of scattered radiation will emerge from that body in all directions; this radiation is known as the scattered radiation. The opening in the side of the shoe-fitting fluoroscopic x-ray machine where the feet are placed is, of necessity, large and a great deal of scattered radiation may come out through it.

There will also be direct, scattered and stray radiation coming up through the fluorescent screen; the persons viewing the image may be protected by a sheet of lead glass placed immediately over the fluorescent screen between the screen and the observer.

In some machines, the transformer tank is so placed as to be one side of the steel or lead enclosure around the x-ray tube. If this tank is not positioned correctly there may be leakage of scattered and stray radiation at the edges where the tank joins the steel cabinet.

(4) *Electrical Hazard*—Since the shoe-fitting x-ray machine has present not only the ordinary line voltage but also voltages as high as 50 K.V., it should be examined for safety from electrical shock.

SCOPE OF EXAMINATION

The shoe-fitting fluoroscopic x-ray machine should be examined to determine:

(1) the intensity of the direct beam on the feet

(2) the radiation leakage, i.e., the intensity of stray and scattered radiation around the machine

(3) the electrical hazard.

INSTRUMENTS

(1) Direct beam measurements can be made with a Victoreen 25 r thimble chamber and associated Model 70 condenser r-unit or similar instrument such as the Kelly-Koett 10 r chamber, K-151, with either charging unit K-135 or charging unit K-122.

(2) Stray radiation or scattered radiation measurements must be made with ionization chamber instruments which show the intensity of the radiation in milliroentgens per hour, and which respond accurately to the long wave radiation here encountered within the five second operating period of the tube. For this long wave length radiation the window or wall of the ionization chamber must be made of material of low atomic

number and be sufficiently thin so that it will not absorb a large amount of the soft x-rays. These instruments should have scales appropriate for the range of intensities encountered. Ionization rate-meters with scales covering the range from 0-2000 milliroentgens per hour are satisfactory for measuring the scattered and stray radiation if provided with rapid-response circuits.

Types of instruments suitable for this measurement are the Beckman MX-2 survey meter with scales 0-20, 0-50, 0-100, 0-500 and 0-200 mr/hr., the Tracerlab SU-1B portable radiation survey meter (Cutie Pie) with scales 0-25, 0-250 and 0-25000 mr/hr., and the Kelly-Koett model 350 ionization meter with scales 0-5, 0-50 0-500, 0-5000, 0-50000 mr/hr.

Pocket chambers or dosimeters of 200 milliroentgens capacity are satisfactory for evaluating the daily dose received by exposed workers and these can also be employed for evaluating the stray radiation.

To determine if there are any small pin-point radiation leaks in the sides of the machine, a Geiger-Meuller counter may be used.

METHODS FOR TESTING HAZARDS

(1) *Direct Beam*—To measure the intensity of the direct beam, readings should be taken with the Victoreen 25 r thimble chamber placed two to three centimeters above the foot pedal of the x-ray shoe machine at the normal position of the feet. Measurements should also be made at various positions across the foot pedal in order to determine the position of the maximum intensity of the beam. Care should be taken in operating the x-ray machine when taking readings with the 25 r thimble chamber, since to secure a suitable reading it may be necessary to operate the x-ray tube for a considerable period of time, i.e. a succession of exposures, and if cooling periods between periods of operations are not allowed the x-ray tube may be overheated and damaged.

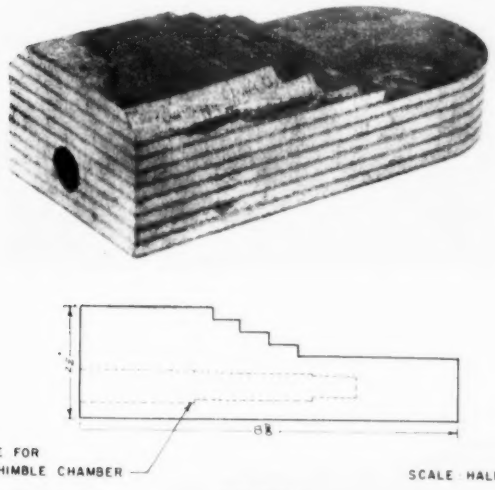
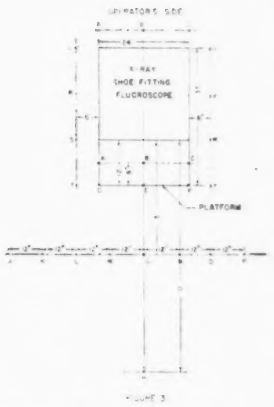


FIGURE 2



To determine the amount of radiation received inside the foot, measurements may be made using a prestwood phantom to simulate the foot; such a phantom is illustrated in Figure 2. Readings are taken with the 10 r or 25 r chamber placed in a suitably drilled hole in the prestwood phantom.

(2) *Scattered and Stray Radiation*—An extensive study of the amounts of scattered and stray radiation should be carried out on all sides of the shoe-fitting fluoroscopic x-ray machine.

As many readings may be taken around the machine as is deemed necessary by the physicist. A sample system is represented in Figure 3. The letters A, B, C, etc., represent the positions at which readings may be taken. At each position, measurements may be made to a height of 60 inches above the floor at intervals of 6 inches.

Scattered and stray radiation measurements should also be taken at eye level at the viewing openings on top of the machine.

These radiation measurements should also be made using prestwood blocks simulating the legs and feet. These blocks serve as the scattering medium.

When the amount of scattered radiation around the x-ray machine is of low order, it may be possible to determine if there are any small pin-point radiation leaks in the sides of the machine by scanning very carefully the sides of the machine with a Geiger counter. This operation cannot be carried out if the general radiation background due to scattered radiation is high.

(3) *Electrical Hazards*—The machine should be checked by the provincial electrical inspector, if it does not have C.S.A. approval. The installation should conform to the local electrical code and should be checked by a competent authority. In particular it should be properly grounded.

RECOMMENDATIONS

Direct Radiation

The amount of damage which may result from over irradiation of the feet has not yet been fully evaluated. It is believed that children's feet in which the bones are still growing may be easily damaged. Until more accurate information is available, it is felt that all unnecessary irradiation should be avoided and that as a minimum precaution, the recommendations of the American Standards Association should be strictly adhered to. The Protection Committee of the Radio-

logical Society of North America passed the following resolution at its meeting in December 1949.

> "The Committee believes that shoe-fitting fluoroscopes should be compelled to comply with A.S.A. code, namely foot exposure shall not exceed 2 roentgens per look, 12 times per year, The committee would prefer that shoe-fitting fluoroscopse, as for any other radiating machine, shall not exceed 0.3 roentgens per week at any place where employees or other persons may be."

The maximum dosage that could be received in one year while still complying with the A.S.A. recommendations would be 12 x 2r = 24 r. This may be compared to the new (1950) recommendations of the International Commission on Radiological Protection, that the permissible dose of radiation should not exceed 0.3 r per week, i.e., approximately 15 r per year.

To comply with the A.S.A. recommendations it is necessary that each machine be fitted with an automatic exposure timer, limiting the exposure duration to a definite and consistent period of from 5 seconds to 10 seconds, and that the output be so adjusted that a maximum of not more than 2 r can be delivered at any point in the foot space during this exposure period.

A warning placard as described in the A.S.A recommendations* should be posted on the top of each shoe-fitting machine to be clearly legible and easily read from the customers side.

A switching arrangement to provide two lower intensities for the examination of women's feet and of children's feet is desirable.

A time-delay switch, which would act after two or two and a fraction exposures, to prevent further operation of the machine for one or two minutes, would also be desirable.

The tube current adjustment, if provided, should be enclosed within the case and should be accessible only to authorized personnel.

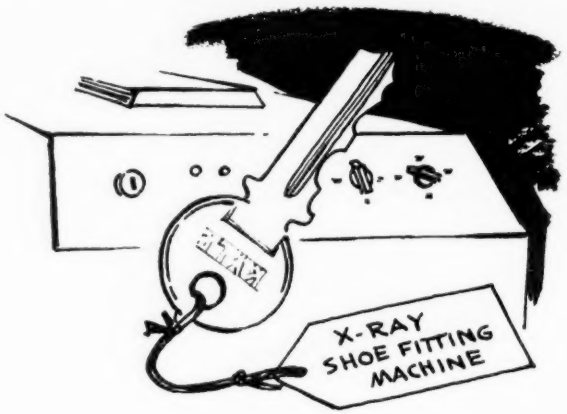
The floor of the foot opening should be covered with a sheet of aluminum at least 1 mm. thick. This aluminum filter should not be part of the wearing surface but should be covered with prestwood, magnesium, aluminum composition, plastic or rubber.

The x-ray output of machines with a fixed tube current can be reduced by increasing the filtration between the tube and the foot with additional aluminum sheets.

If the brightness of the image on the fluoroscopic screen is not adequate, it may be increased by cleaning the lead glass, or by replacing the fluorescent screen, or by rotating the x-ray tube or adjusting its position. If the x-ray tube is replaced or if it is rotated or changed in position the radiation delivered in the foot-space must again be checked and adjustments made, if necessary, so that it remains at less than 2 r per exposure. Brightness *should not* be increased by increasing the tube current, by increasing the input voltage above the range specified by the manufacturer, or by removing the aluminum filter from the foot plate.

It should be impossible for anyone to operate the machine from the customers side of the machine.

A master switch operated by a removable key should be provided so that the machine can be kept locked when not under the direct supervision of the responsible person.



STRAY RADIATION

In view of the recommendations of the International Commission on Radiological Protection, the shielding built into the unit should be sufficient to reduce stray radiation to a very low level. Suggested limits for the stray radiation intensity, or for the total dosage given per exposure by stray radiation at various points around the machine are given below:

(1) At any position above the top surface of the fluoroscope, and at any height above the floor at position Q, R, S, A', B', C', U, V, W, and H, in Fig. 3, the stray radiation intensity during an exposure should not exceed 6.25 milliroentgens per hour, as measured by one of the ionization rate-meter instruments mentioned earlier

(2) At any height above the floor, in any of the positions G, H, J, K, L, M, N, O, P, of Fig. 3 the stray radiation intensity during an exposure

*Warning Signs. The installation shall be provided with a conspicuously located sign warning the customer that repeated exposure to x-rays may be harmful. The sign should measure at least 7½ in. by 4½ in., be placed in a conspicuous position and contain the following warning:

> "Repeated exposure to x-rays may be harmful. Fluoroscopic examinations for shoe fitting should be limited to no more than 12 in one year."

should not exceed 50 milliroentgens per hour.

(3) At any of the points A, B, C, D, E, F, T and Y, 18" or more above the level of the foot platform, the stray radiation intensity should not exceed 6.25 milliroentgens per hour.

(4) At any of these same points, less than 18" above the level of the foot platform, the radiation dosage received per exposure, averaged over 10 exposures as measured by a Victoreen 200 mr chamber or by pocket chambers or pocket dosimeters, for 10 exposures should not exceed 5 milliroentgens.

(5) At any height above the floor in any of the positions A, B, C, D, E, F, G, J, K, L, M, N, O, P. of Fig. 3, with the entrance to the foot space completely blocked with a vertical land sheet, the stray radiation intensity should not exceed 6.25 milliroentgens per hour.

SCATTERED RADIATION

With foot and leg phantoms in place the dosage per exposure averaged over ten exposures at any height greater than 18" above the foot platform, at points A, B, C. D, E, F, T and Y, should not exceed 5 milliroentgens and at any height, at points G, H, J, K, L, M, N, O, P, the dosage *rate* should not exceed 50 milliroentgens per hour.

The scattered and stray radiation can be limited by proper design of the foot opening, by tube shielding which limits irradiation to the area of the feet which can be seen on the fluoroscopic screen and by the provision of a curtain made of flexible, overlapping strips of lead-rubber at the entrance to the foot opening.

OPERATION

Some one person should be responsible for the machine and its operation and should have the key to the switch. He should not delegate operation of the machine to others without adequate instruction.

The person operating the machine should *always* show the customer the A.S.A. placard before the customer makes use of the fluoroscopic shoe-fitting machine.

The customer must have shoes on both feet at the time of x-ray examination.

The clerk must not place his own hands or feet in the x-ray beam to demonstrate the machine.

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NOTE: —Photostatic copies of the above may be borrowed from the Radiology Laboratory, Division of Physics, National Research Council, Sussex Street, Ottawa, or from Health Radiation Section, Industrial Health Division, Dept. of Health and Welfare, 200 Kent Street, Ottawa.

Scope of Medical Services IN INDUSTRY

From time to time an appraisal is essential for good administration of health services in industry. A concise guide is presented here to indicate in principle the trend of the scope of health services in Canadian industry. It is recognized that these principles should be adapted to meet the needs of the particular industry by the medical staff supervising the services. They have been listed below in broad outline because of the many requests for this information.

The scope includes:

I. Emergency care:
(1) Early and efficient care for occupational accidents and illnesses. Under the provincial workmen's compensation acts disabled persons have some freedom in choosing their own physician.
(2) Emergency care for non-occupational accidents and illnesses. For further treatment patients are referred to their own physicians.

II. Health examinations:
Preplacement and periodic examinations with active participation in programs for vocational guidance and rehabilitation.

II. Supervision of the occupational environment:
This includes potential occupational hazards, safety programs, plant sanitation, nutrition and other facilities associated with health. This will necessitate close cooperation with others who share responsibility and interest in the matter.

IV. Health education and counselling:
(1) Education: health education, nutrition, management of illness and so forth.
(2) Counselling: assisting employees in their process of adjustment for greater efficiency and happiness in work; also to counsel the worried worker, accident-prone personality, and those with problems of adjustment to fellow workers and work patterns. Personnel and industrial relations.
(3) Group teaching—usually to be developed in an industrial health service. Employee participation is essential to success.

V. Record System:
Adequate simple records are essential for any industrial health service. Records are required for compensation purposes and the assessment of tangible and intangible benefits to be derived from the medical service.

VI. Home visiting by nursing personnel based on well defined objectives, these to be reviewed periodically in relation to the total health service.

The Industrial Nurse
IN THE COMMUNITY

By Ann Peverley, R.N., B.Sc., Assistant Professor
Public Health Nursing
School for Graduate Nurses, McGill University

As nurses and as citizens it is well for us to remember that we are part of the community. We share with other groups and other persons many privileges and responsibilities. The nature of our work brings us into close contact with people — human beings like ourselves who have feelings, needs, hopes, fears and potentialities.

Nursing, concerned as it is with the fundamental needs of all people, cannot be conceived of to-day apart from the society in which it functions. Many of the problems facing nursing have their counterpart in the larger social issues and problems of the day. Nursing throughout the world, as represented by the International Council of Nurses, does not stand for a narrow professionalism but for that full development of the human being and citizen in every nurse which shall enable her to bring her professional knowledge and skill to the many sided services that modern society demands. As the result of the influence of the industrial revolution upon modern society, we see changes in the health problems and needs of the individual, and in the pattern of medical and nursing care to meet these changing needs.

Nurses to-day, all over the world, are re-thinking their approach to the nursing needs of people. We are considering, too, our interpretation of those needs as well as a change in emphasis in our work as we attempt

to prepare ourselves better to assist in meeting some of the community needs. You will notice that I say "to assist" in meeting some of the needs. We have recognized I think that successful effort is largely the result of intelligent teamwork among the various community agencies. It is at this point that I invite you to think specifically of the nurse in the community whose efforts are directed towards the health and well being of the breadwinner at his or her place of employment.

In discussing the hidden opportunities of industrial nursing, Dr. W. E. Doyle of the United States Public Health Service pointed out some time ago that the health and welfare of the worker is inseparable from the health of the community, so that the nurse in industry must take an interest and an active part in her community program. Because her duties are directly influenced by community health problems, she often does and should find it necessary to cooperate actively with the community health program. It has been aptly said that, "with the sphere of influence of industrial nurses as broad as it is to-day, they cannot be plant conscious and community indifferent. The opportunities are ever present for industrial nurses to utilize their high degree of specialized knowledge for the health of all."

In looking back over the history of industrial nursing in Canada during the past forty years it is interesting to notice that it began in a small way as a family health service and that it was with the advent of workmen's compensation legislation that the emphasis changed to emergency care. In the early days indust-

rial nursing placed little emphasis on the care of injuries. It was essentially a home visiting service with calls coming through physicians. We read that in the Vermont Marble Company service was free to employees and their families and to others in the town who were unable to pay. Miss McGrath tells us that the industrial nurse of that day found herself making home calls upon obstetrical patients and caring for typhoid patients as well as giving talks to the children in the school. Then as now the industrial nurse found her job reaching out into the community. Records for 1896-1898 are interesting, showing that obstetrical cases topped the list with medical cases a close second while surgical cases were few. As time went on the program developed, as you know, into one of health and welfare supervision, until at the turn of the century we find the Metropolitan Life Insurance Company experimenting in home nursing as a service to holders of industrial policies. It has now become recognized that industrial nurses, whether engaged directly in service to workers or in an advisory capacity to other industrial nurses, are a part of the complex pattern of community health facilities. They need to know the work of other public health nurses in both official and private agencies in order to cooperate effectively for the benefit of those for whom all provide some service. The converse is also true. Nurses in the official and private agencies need to have a better understanding of the work of the nurses in industry. More emphasis could well be placed upon better interpretation of our various services both within and outside the profession.

I would venture to say that the nurses in industry are themselves becoming increasingly conscious of the fact that they are part of a community team, and a very thoughtful part, seeking greater understanding and skill in meeting health needs. We are meeting together here during the next three days to discuss common nursing problems, to gain new knowledge and to recognize newer trends. It is interesting to notice that at this present moment American physicians and surgeons specializing in occupational medicine are attending the 10th International Congress on Medecine for Workers which is being held in Lisbon, Portugal. As we view the world community we see industrial nurses and physicians studying better ways of meeting the health needs of industrial workers.

In the United States last April, navy medical officers and industrial hygienists met to discuss common problems relating to "maximum productive efficiency through health conservation." What else is happening among industrial nurses in the community? If any of you were fortunate enough to have been in Scotland during the month of July you might have joined with sixty other nurses in industrial study days. Like yourselves, these experienced nurses left a very busy service field for a few days in order to gain further knowledge and insight to enable them to do a better nursing job in the community.

In Finland a very significant event took place last May when the First Scandinavian Congress for Industrial Medicine and Hygiene met there. At the same time there was the official opening of the new Institute of Occupational Health. You might be interested in the *Nursing Times'* description of this institute as a modern structure surrounded by other new buildings of Helsinki's rapidly developing medical centre. It houses technical experts in industrial health, medicine

and safety, and has facilities for in- and out-patient work. The experts are available as instructors in conjunction with the university and as consultants to industry. Finland, as you know, has many small factories which could not finance a full health service for themselves. In the institute, the nucleus of a scheme to provide them with health supervision is beginning to form. The nursing side is under the guidance of their nurse consultant who has already organized for industrial nurses two successful training courses in the post-certificate training school of the neighboring College of Nursing. The Rockefeller Foundation, to whose generosity the institute owes much, sent a representative to the official opening. Representatives were also present from the World Health Organization, International Labor Office, Great Britain, France, Germany, Yugoslavia, Poland and three Scandinavian countries.

Following the Congress for Industrial Medicine and Hygiene a ceremony took place at which certificates and badges were awarded to the class of industrial nurses who had just successfully completed their training course (the second to be held in Finland). You might be interested to know that this first course lasted two months and was organized for experienced industrial nurses already holding a public health qualification. The second course was for experienced industrial nurses without previous qualification in public health work. It extended over eight months, of which four were given to theoretical instruction and four to field experience. Each successful candidate received a written statement of her examination results and a circular badge similar to that issued to other public health nurses but with the edge cut like a cog wheel.

Many other significant things are happening in this great community of which we are a part. On this continent, community action has recently been well demonstrated in California where a League of Women Voters promoted interest in the industrial health of their community by requesting the Bureau of Adult Health to supply a speaker to discuss the problems. As a result, a meeting was held at which representatives from the league, the community welfare council, the chamber of commerce, the county medical society, and the local health department participated. A probable result of the conference will be the establishment of a committee to review the local situation and to work closely with the health officer in developing interest in improving health in industry. The hope is expressed in the *Industrial Health Monthly* magazine that this step will be followed by specific fact-finding studies of industrial health and a well-planned program integrating all the community resources. It is important that we remember that some communities at least want to be better informed about industrial health services.

Up to this point we have been looking at a broad picture, against which I have tried to highlight four main points,

1. It is well for us to recognize that we, as citizens and nurses, should be a live part of our community.
2. We are concerned with the nursing needs of people in a complex and rapidly changing time.
3. There are still many hidden opportunities in industrial nursing.
4. There is ample evidence to show that in this field a forward movement is taking place and great progress is to be expected through quality nursing service given by experienced and prepared nurses ready to take their place in the community team.

Now, with this as a background, let us direct our thinking from these general considerations to something more specific.

One of the functions of the industrial nurse, in the interests of the employee and management, is to counsel employees in matters relating to health and welfare. As source material for counselling and referrals the nurse may profitably keep information on file about community health, welfare, recreation and adult health resources. As we think in terms of the worker and his needs, let us mention very briefly a few of the community agencies which should work together and which may be used by the industrial nurse as the need arises.

You may recall that Margaret Sharp of the Esso Standard Oil Company said: "It is only as the nurse keeps herself aware of the community resources available that she can utilize them in behalf of patients or their families. Much of the work and value of the nurse to her employer and to her community lies in her awareness and inventiveness in solving each new need as it occurs." Here, I think, it is important to remember that management belongs to and supports community organizations and should be aware of agencies contacted by the nurse.

Under the heading of community health resources we might include the plant physician, the family physician, the industrial nurse, the hospital nurse and the visiting nurse. In this connection it is interesting to remember that experimental programs have been set up to meet the needs of the smaller plant, and in 1948 in the United States these projects were sponsored

by different agencies including medical societies, departments of labor and health, medical practice groups and visiting nurse associations. Since 1941 the Visiting Nurse Service of New York has offered part-time nursing service to plants too small to make it practical to employ a full time nurse. During the peak of their industrial service, the Visiting Nurse Service was reaching about 6,000 of the million or more workers in small plants in New York City. Today, in Canada, thirteen branches of the Victorian Order of Nurses supply part-time service to industry.

Other agencies in our community include hospitals and out-patient departments, emergency first-aid service, departments of health and special health organizations. It has been said that modern industry is the logical partner of the health department in bringing workers and their families all of the new and rapidly growing fund of knowledge for preventing illness and improving health.

The industrial nurse can also use more child guidance clinics as a resource. There are situations in which you find that the father's problems are creating emotional difficulties for the children. If you help to work out a referral to a child guidance clinic in such a case you will not only be furthering preventive work but if the children get help, you will indirectly aid the father. The father's adjustment on the job may be quite definitely affected by the problems going on in the home. I might add here that it is essential that we as nurses have a better knowledge and understanding of human behavior, of principles of mental health and of ourselves. Skill and sensitivity in appraising the mental as well as physical health of each person with whom the nurse works must be used and developed so that she can decide what her part is in helping the employee and so that she may know when to refer him to other sources for more specialized psychiatric case work or other services.

We should all be ready to use other sources of help since no one person can be "everything to everybody." I would mention here also the Social Service Index as an indispensable community resource, as well as the directory of community agencies.

Under the heading of welfare, we might think of checking our knowledge of day care facilities for children of working mothers, institutions for the chronically ill, legal aid societies and agencies which care for unmarried mothers. The worker who is worried about a child, a chronically ill person at home or a legal difficulty may be helped by the nurse who knows how to use community facilities. Industrial workers are members of families and of social units and we need to remember that many of their problems arising from the environment outside the plant have a bearing on their work. Nurses in industry usually have fewer occasions to call upon relief agencies than nurses of local health departments and visiting nurse associationt because the industrial nurse is usually working with persons employed full time.

From the point of view of adult education the nurse needs to know something of recreational facilities and rehabilitation centers within the community. We need to be at least aware, for instance, that there are industrial and penitentiary training programs. You may recall an article on this subject in the December 1950 issue of the *Industrial Health Bulletin,* which stressed the point that Canadian industry and labor can play an increasingly important part in the rehabilitation of men and women released from penitentiaries.

Then there is that group of older workers in industry who need the nurses help in planning for retirement. The industrial nurse may help by interpreting existing facilities for constructive off-the-job activities and encouraging the worker to make use of them. The industrial nurse's knowledge and enthusiasm may be the influence needed to foster the employee's interest in planning for retirement. If you have not already done so, you might be interested in reading an article on this subject by Blanche Bishop in the February 1951 issue of the *Canadian Nurse*. Miss Bishop's article is entitled "Problems of the Older Worker in Industry."

In considering adult education, it is recognized that health education is part of the function of every nurse. In order to carry out this function we all need to be prepared to teach and to know community sources which provide teaching aids. I would like to sugges too, that university schools of medicine and nursing could be used to far greater extent in professional education of those members concerned with health and welfare in industry.

In closing, I feel that I can do no better than make reference to what has already been said by nurses working in the field of industry. Miss Mabelle Markee of the industrial hygiene division, United States Public Health Service in 1948 referred to the fact that education is a growing responsibility of all the nurses in industry not only to develop themselves in their present positions but also to prepare to serve as teachers and as leaders of others.

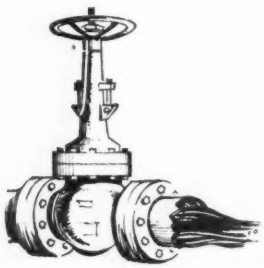
A year later, Miss Mildred E.Dunn, said, "The aim of education for the nurse in industry is twofold. Not only must she learn certain essential techniques but she must also develop a deeper appreciation of the problems confronting her as a member of the health team. This appreciation will only be as real as the effort the nurse puts forth in discharging her daily obligations. For the nurse, education is a life-long process and each learning experience paves the way for future progress."

The Radiation Problem

AND PHYSICS IN INDUSTRIAL HEALTH

By Antoine Aumont, Physicist
Division of Industrial Health
Department of Health, Quebec

X-rays and isotope radiations offer, in our times, working instruments which are being more and more developed. Their property of penetrating opaque matter according to specific laws of physics makes them instruments of diagnosis for the physician and checking devices for parts and the analysis of products for the manufacturer. Their ionization power and their tracing properties serve, in medicine, for research and in the treatment of certain diseases. In industry, radioactive elements may be used in several ways, for instance, as a method for measuring the thickness of laminated sheets, as a radiation source to determine flaws in metals, as static electricity eliminators, as indicators in the transportation of oil in pipe-lines, etc.



However, these properties of ionizing bodies also can be a source of danger to those who are exposed to more or less considerable quantities of radiations and this danger is the greater because it is not felt immediately, like that of a too bright light or a too intense heat.

Therefore, it has been necessary to learn more about the dangers presented by these physical agents. Detection and radiation measurement methods had to be evolved and courses teaching the means of detecting such radiations and protecting personnel had to be set up in an efficient manner. Basic science is taught at such courses—the handling of measurement devices, nuclear physics which deals with atoms, radioactivity and radiations.

The main principles

Atoms are composed of a central nucleus of protons or hydrogen nucleii which carry a positive electric charge, and of neutrons, electrically neutral, of the same mass as the proton. Around the nucleus are gravitating electrons, very light negatively-charged particles, the role of which is to neutralize the positive field formed by the protons of the nucleus. The neutron can divide itself into both protons and electrons. The proton, on the other hand, can transform itself into neutrons and positrons. The positron is a positive particle with the same mass as the electron.

An atom, when whole, is electrically neutral but if it loses one of its electrons, it is said to be "ionized" and the name "ions" is given to the remainder of the atom and to the separated electron. The former has a positive charge and the latter a negative charge. Ionization occurs each time the atom receives from the outside a sufficient force either in the form of a high speed particle or of a radiation of the same type as light.

A body is said to be radioactive when one of the integral parts of the nucleus of its atoms becomes separated from the latter or is transformed with loss of energy in the form of radiations or high speed particles. Through this disintegration, the chemical species or the mass of atoms is changed but this activity does not simultaneously affect all the atoms. Its frequency follows the laws of probability and depends, in actual fact, upon the number of atoms present.

In addition to their ionizing property, high speed particles and high energy radiations have the property of rendering radioactive, or even causing the explosion of, the atom nucleii which they strike. Similarly, they produce, in the electron layers of these atoms, electromagnetic perturbations known as x-rays. This is the property used in certain vacuum tubes, called x-ray tubes, where electrons are projected, under a tension of several thousands of volts, upon a target called the anticathode.

Under the generic term of radiations are included:

Alpha particles which are doubly-ionized helium atoms. Their initial speed is of the order of 15,000 miles per second and their ionization power is the greater when they are the slower; such particles have little penetrating power; a single sheet of paper stops them:

Beta particles, which are positive or negative electrons travelling at speeds close to that of light; they have much less ionizing power than alpha particles but this power also increases when their speed decreases. However, they have much more penetrating power than alpha particles:

X-rays and gamma rays which are radiations in the true sense of the word, that is, electromagnetic oscillations of the same nature as light. Their energy is the greatest when their frequency is the highest, or conversely, when their wave length is the shortest. The degree of their penetration is a direct function of their energy. Their degree of penetration is greater than that of beta particles.

We shall mention only those which are the most fre-

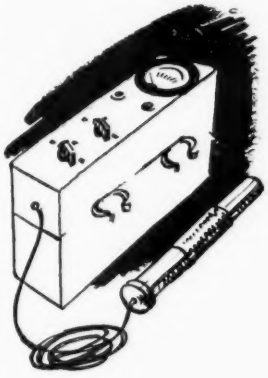
quently used in industry. There are also neutrons, protons, deuterons, etc., which are mostly found in laboratories.

Measurements

The unit which has been universally adopted in the measurement of radiations is the roentgen, an amount of ionization in dry air, and this explains why many ordinary instruments of measure are based upon that principle. Let us suppose an ion is placed between two metallic plates, one positively charged and the other with a negative charge. The ion will travel towards the plate bearing the sign contrary to its own, and this generates a very slight current or at least a change of charge of that plate or electrode. A current or change of charge that is so slight is not measurable but when it is known that an alpha particle produces upon its passage hundreds of thousands of ions it is realized that this current becomes appreciable if the number of particles per second is sufficient. The device which we have just described is called an ionization chamber and often the two electrodes, instead of being plates are, on the one hand, a cylinder and the other, a rod which passes through its centre axis.

When the electrical potential of the ionization chamber is raised above a certain value, ions formed will reach only a sufficient speed to permit them to form others so that the initial current caused by the passage of the particle will be amplified. We then have what is called a proportional chamber.

It will even be possible, under determined conditions of pressure and potential, to amplify an almost unlimited number of times the passage of each particle. Secondary ions produce other ions and the process snowballs until the current is interrupted by a mechanism of the circuit and according to the nature of the gas contained in the chamber. Such a chamber is called a Geiger tube. It permits the individual counting of each particle which crosses it. Counting is done through an acoustical or mechanical method or with an electronic scaler. This counting method was the origin, for radioactive substances, of another unit borrowed from radon, e.g., the curie which is equal to 3.7×10^{01} or 37,000,000,000 disintegrations per second.



Another way of determining the amount of radiation received is the blackening of a photographic plate under the action of radiations and its comparison with another plate which has received a determined amount of the same quality of radiations.

Other devices such as scintillation counters and crystal counters are developed under different principles and appear to be quite promising.

Radiation measurement would be simple if each radioactive body or each x-ray device would give only one kind of radiation of a determined energy. However, that radiation, complex by itself, generates through its action upon surrounding matter what may be intense phenomena of secondary emission of radiations or induced radioactivity. The problem is therefore multiple and depends both upon the x-ray apparatus itself (or of radioactive substances) and surrounding objects.

Practical problems

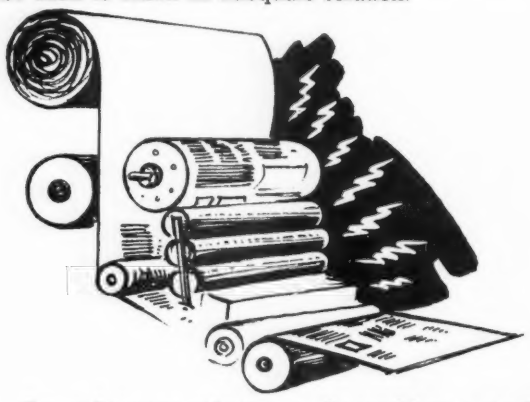
Let us take the concrete example of an x-ray device designed for fluoroscopy where the operator must be in the same room, and let us suppose, for greater precision, that it operates under a potential of 80 kilovolts and an output of 10 milliamperes. This lone indication will be quite vague if it is a question of appreciating the amounts of radiation from the point of view of protection. The energy of radiation as produced at the anticathode is not homogenous even when the potential is absolutely constant. It is a resultant from a whole set of radiations of quite different energies the distribution of which, when putting intensity in relation with energy, forms a curve which is identified with the x-ray spectrum.

The composition of the x-ray spectrum varies according to a large number of factors such as the composition of the anticathode, the form and the value of the electrical potential used, the absorbent substances which serve as a filter for the radiations and even the distance in relation to the device. Let us add that these are only characteristics of the useful beam and that these radiations are absorbed, reflected and diffused in all directions and each according to its energy in the bodies. It crosses these somewhat like light which passes through a fluorescent substance.

If, moreover, we add that according to the position inside or outside the useful beam, the resultant of the specter takes quite different values in intensity and in average energy, we shall then have some idea of one of the problems of industrial health—how to determine simultaneously the intensity and the energy of the radiations received by such an x-ray operator.

With such complex factors, calculations prove insufficent. Measurements must be taken and this is difficult at times because the detection devices respond more or less well according to the energy of radiations. The vest-pocket fountain-pen style ionization chambers give an approximate idea of the quantity but do not indicate energy and are often subject to atmospheric variations such as temperature, barometric pressure and humidity. A technique has been developed for the use of dental films used with various filters. Results are satisfactory as to quantity and energy but they must

be "standardized" for each type of x-ray device and each series of films. Let us observe here that the expression "satisfactory" indicates a compromise between *less well* and *better* and that much remains to be done to reach an adequate solution.



For radioactive substances, the problem is similar Let us take the concrete case of the ionotron or static electricity eliminator. The purpose of the ionotron is to cause in the air an ionization which makes it a conductor and prevents static electricity from forming on the surface of certain dielectric substances (such as paper which circulates upon the rollers of printing presses) and to cause poor operation of machines and in certain cases risks such as explosions, fires, etc.

The ionotron is composed of a metallic plate upon which is spread as evenly as possible a thin layer of a radioactive substance which can emit alpha particles. When this substance is covered with a metal film it retains the substance while permitting the passage of the greatest part of the particles—about 70%—of alpha particles and all of the beta and gamma rays. Usually the radioactive substance is radium in equilibrum with its disintegration products, about ten of them, all radioactive except for lead. The whole gives three spectra of a different nature: a spectrum of alpha particles, one of beta particles and one of gamma rays. The first and the last are discontinuous spectra and include only a few bands of radiations of separate energy, the values of which are distributed between some thousands and some millions of electron volts. The spectrum of beta particles is a continuous spectrum and its form resembles that of x-rays.

Each of these radiations behaves in its own way and can again cause, by striking surrounding matter, other phenomena of induced radioactivity or secondary radiations having the characteristics of x-rays.

When it is a question of assessing the protection of personnel in more or less direct and frequent contact with such devices, one must be content with nearly exact measurements because the measuring instrument reacts differently to each of these radiations and if it is desired to eliminate one by filtering it, others are also filtered at the expense of accuracy.

To ensure efficient protection it is then necessary to use the most certain means even though they are less practical and less economical. Such means imply the use of the greatest distance possible and radiation absorbing screens. In addition, it is necessary when one is unavoidably close to such devices for some time to limit the exposure time as much as possible.

Overall picture of the problem

The problem of field measurement of radiations thus appears to be as follows:

> The measurement device has an efficiency which varies with each type of radiation.
> For one type of radiation the efficiency of the measuring device varies with the energy of the radiation.
> It is difficult with the present portable devices to separate, in order to measure them individually, the different types and the varying energies of radiations without hampering the accuracy of measurements.

Such difficulties are obvious through methods of interpretation by interposing filtrating material but the solution of the problem seems to lie in another direction and include three conditions:

(1) Finding some device which separately measures the different types of radiation. The scintillation meter seems promising in that direction but, at the present time at least, it is impossible to use it as a vest-pocket ionization chamber.

(2) Finding some device which gives an idea of the energy of radiation received. The photographic plate partly solves that problem but we have seen above what must be thought of it.

(3) Finding some device which equally reacts to all energies of radiation. It is, for portable devices, the most difficult part of the solution. Ionization chambers of the *survey meter* type appear to give the best results in that direction.

The physicist's work will then consist, in this sphere, of assessing the working conditions in proximity with x-ray devices or an installation of radioactive substances; of interpreting readings of such measuring instruments at various points around such installations and of recommending efficient precautionary measures to be taken. He also shall have to check concentrations of harmful radioactive substances in the air or upon objects. Something also will remain to be done—finding portable measuring devices which are cheap, efficient and accurate which will enable the physicist to assess more accurately the working conditions of personnel exposed to radiations and to ensure the maintenance of these devices. Great progress has been realized in this field but considerable work remains to be done both in research and in the protection of exposed personnel.

The Collection and Utilization of Data on Lost-Time-Morbidity in Industry*

By W. H. H. Bishop and R. B. Sutherland, M.D., D.P.H.
Division of Industrial Hygiene
and
W. B. Marr and A. H. Sellers, M.D., D.P.H.
Division of Medical Statistics
Department of Health for Ontario

Industry provides an excellent opportunity for lost-time morbidity studies since it is possible to arrange for the reporting of disease and injury absences as well as for the necessary population data on which to base rates.

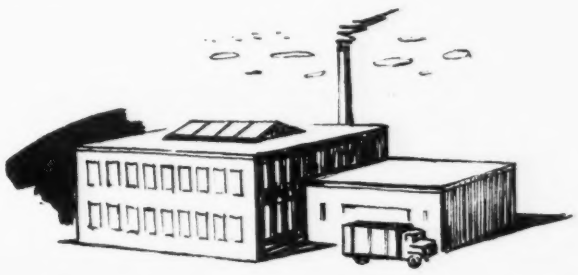
Records of morbidity absence afford essential data for any study of the general effect of environmental conditions upon health. They provide information on the variations in the health of workers (as measured by morbidity) which may occur in various departments and occupation groups. In addition, they are of value to management in planning and administration. They assist in estimating such charges against operation as extra staff to replace the absentees, time and production losses due to disease and injury which leave machines idle, etc.

Management must be concerned primarily with the "lost-time" feature of the morbidity record, while industrial physicians are interested in the effect of disease and injury on the worker and the absence which it does or may produce. A record system designed solely for the use of one group will not meet the needs of the other. This fact, and the necessity of keeping to a minimum the machinery for collecting and analyzing the records, have produced a wide variety of systems in current use. A recent survey by the division of industrial hygiene, Department of Health for Ontario, showed that of 53 plants in Ontario with relatively good medical programs and employing full-time nurses, only 20 had figures on lost-time morbidity experience. The basis for recording morbidity absences and the calculations used in deriving rates varied so widely from plant to plant that only the most general comparisons could be made. This situation has been found in other countries.

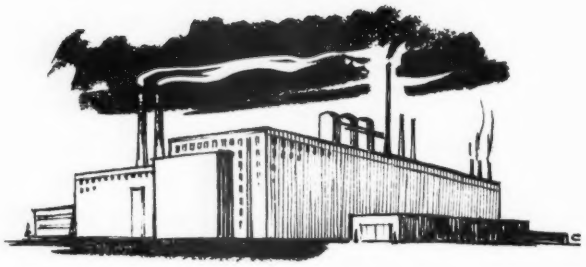
Two attempts have been made in the past to establish some uniformity in morbidity recording.

The division of industrial hygiene of the National Institute of Health, U.S. Public Health Service, prepared in 1940 a "Proposed Plan for the Recording of Industrial Absenteeism" utilizing a dual-purpose punch card of the Hollerith type. With the same objective, in 1944 the Industrial Health Research Board of the Medical Research Council of Great Britain published a report on "The Recording of Sickness Absence in Industry". This plan used an individual employee absence record card. The British system used working days absent as the measure of lost time, the American system used calendar days. The British system does not permit analysis of data by age groups, and tabulations were to be made by hand. The American system was restricted in that mechanical tabulation facilities were required.

To stimulate interest in the uniform recording of morbidity absenteeism in industry the division of medical statistics and the division of industrial hygiene of the Department of Health for Ontario have been studying systems of recording lost-time morbidity which would meet all needs. Interest was first centred upon a system suitable for plants of less than 500 employees. A marginally punched industrial morbidity card was designed for this purpose and used in an analysis of morbidity absence records over a three-year period in a plant in the Niagara Peninsula. The punching of this card is done by hand and the card is not recommended for use in plants with over 500 employees due to the volume of clerical work involved. Following publication of the "Manual of the International Statistical Classification of Diseases, Injuries and Causes of Death" by the World Health Organization in 1948, the marginal punch card and the inclusions in the various diagnosis groupings used in analyzing the punch card data were modified to conform with the manual.



*Based upon a paper presented to the Vital Statistics Section of the Canadian Public Health Association, June, 1950.



For larger plants with mechanical tabulation equipment, a dual-purpose industrial morbidity punch card was developed. For small plants, a simple hand tabulation system of recording lost-time morbidity was developed, utilizing an individual morbidity record card 5" by 8" in size.

These three alternative morbidity absence record cards cover the requirements of plants of all sizes and produce data of a basically comparable character. Monographs describing the use of these three systems for producing data on lost-time morbidity have been prepared.

Interpretation of Terms

Certain terms relating to causes of morbidity, such as "disease", "injury", "sickness" and "accident" are commonly used rather loosely. The Manual of the International Classification separates causes of morbidity into disease and injury and in the section on injury includes a few conditions which are commonly regarded as occupational or non-occupational sickness. For this reason, terms used in connection with our morbidity record systems have been defined in Appendix A. For industrial morbidity recording, it is desirable to be able to group data relating to all diseases and injuries into (1) non-occupational sickness, (2) occupational sickness, (3) non-occupational accident, and (4) occupational accident, and at the same time to be able to reconstitute the causes of morbidity according to the section headings of the manual. It will be noted that the terms "sickness" and "accident", as distinct from "disease" and "injury" are used in conjunction with industrial morbidity of occupational or non-occupational origin.

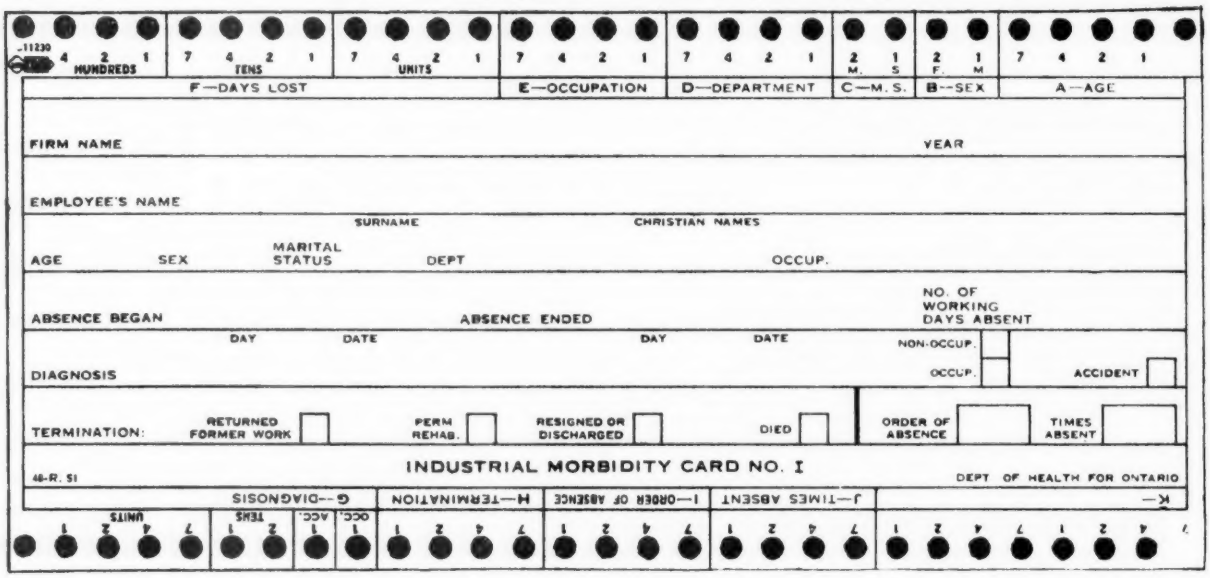


FIGURE 1

The Marginal Punch Card

The marginal punch card (Figure 1) is 3¼ by 7¼ in size. The perforated margins of the card are divided into fields each relating to a section of the recording area of the card. The name of firm, year, employee's name, date illness began and date illness ended are recorded in the central part of the card. These items are not punched. The other information entered on the card includes age (field A), sex (field B), marital status (field C), department (field D), occupation (field E), number of working days absent (field F), diagnosis (field G), termination (field H), order of absence (field I), and number of times absent (field J). This information is punched by numerical code in the appropriate fields along the margins of the card. Absences which are occupational in origin and or due to accident are "tagged" by punching in field G.

Collection of Data

One card is completed for each disease or injury absence causing lost time from work of one full day or more. The cards should be kept separate by calendar year of onset.

To secure information on "number of times absent" and "order of absence", the filing of the card must be strictly alphabetical.

A year's experience is not complete until all absences beginning in that year have been terminated,

or until one month after the end of the year, when the days lost of the few absences still unterminated are estimated and entered on the appropriate card.

A card may be initiated on the first day of an employee's absence due to disease or injury, through the operation of an effective system of reporting absences. The following items should be entered on the card at this time: employee's name, name of company, age last birthday, sex, marital status, department, occupation and date absence began. If the company is to process its own cards, the name of the company may be omitted; if tabulation is to be done elsewhere, it must be entered to ensure identification by company.

The card is completed when the employee returns to work or when the absence is terminated by death, removal from payroll, or other cause. It is essential to the accuracy of the reporting that the employee pass through the plant medical department on returning from an absence. At this time the doctor or nurse records the necessary information, particularly that relating to diagnosis, and completes or arranges for completing the remaining entries on the card.

Recording and Coding of Data

The codes which are suggested may be extended or condensed either in scope or in detail.

The age to be entered is the employee's age at last birthday. Five groups are suggested: under 25 years, 25-34 years, 35-44 years, 45-54 years, and 55 years and over. The department in which the employee was working and the occupation at which he was employed when the disease or injury occurred are both to be recorded. The code numbers used may be decided by grouping to secure the most useful data.

The date absence began is the first full day off duty The date absence ended is the first full day of return to duty. All absences of one full working day or more are to be counted. Absences lasting only one-half day are not to be included. The total number of days lost is to be punched. For tabulation purposes, it is recommended that the duration of absence in working days be grouped as follows: single days up to seven and then in groups—8–14, 15–28, 29–70, and 71 and over.

The termination or outcome of each absence may be indicated by entering an "x" in the appropriate box on the marginal punch card.

The order of absence designates whether the card covers the employee's first, second, or other morbidity absence during the year. The entry should be made at the time the card is finalized on termination of the absence and a check of previous absence cards should be made to ensure correct entry.

The number of times any employee was absent through either disease or injury during any one calendar year will be determined by counting all the cards for the year. This number will be entered on each of his cards in the appropriate space. The coding and punching of the entries in both the order of absence field and times absent field is self-evident.

Non-occupational or occupational absences are indicated by placing an "x" in the appropriate box and by punching in the occupational position in field G, if warranted. Absences due to accident are designated in a similar manner.

The diagnosis which is to be recorded is the final diagnosis available when the absence is terminated. This diagnosis is to be coded and entered in field G.

A list of diagnosis groups, based on the international classification, follows below. This list covers 16 of the 17 sections of the international classification and contains two additional sub-divisions. The one section which is not included is number 15, diseases of early infancy.

No.	DIAGNOSIS GROUPS	Internat. Classif. Numbers Included
1	Acute upper respiratory infections	470 - 475, 481 pt.
2	Other diseases of the respiratory system	480 - 527
3	Diseases of the digestive system	530 - 587
4	Disorders of menstruation	634
5	Symptoms and ill-defined conditions	780 - 795
6	Accidents, poisonings and violence	800 - 999
7	Other specified causes	
8	Infective and parasitic diseases	001 - 138
9	Neoplasms	140 - 239
10	Allergic, endocrine, nutritional diseases	240 - 289
11	Diseases of the blood and blood forming organs	290 - 299
12	Mental, psychoneurotic and personality disorders	300 - 326
13	Diseases of the nervous system and sense organs	330 - 398
14	Diseases of the circulatory system	400 - 468
15	Diseases of the genito-urinary system (except menstruation)	590 - 637 (except 634)
16	Deliveries, complications of pregnancy and childbirth	640 - 680
17	Diseases of the skin and cellular tissue	690 - 716
18	Diseases of the bones and organs of movement	720 - 749
19	Congenital malformations	750 - 759

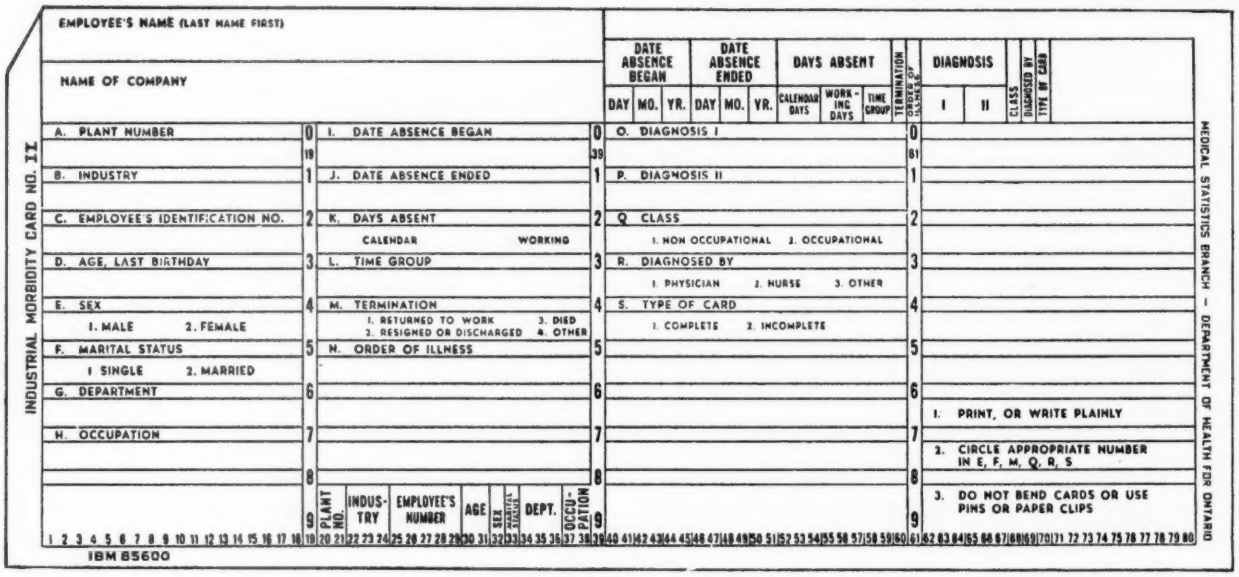


FIGURE 2

Following each of the eighteen diagnosis groups is shown the code number from the international classification. The numbers to be used for coding and punching in connection with the marginal punch card are given in the first column. Group number 7 is not to be punched, since this is a summation of the groups numbered 8 to 19 inclusive.

Field K has been left to provide space for the recording and punching of additional information which may be desired in individual plants.

THE DUAL-PURPOSE PUNCH CARD

The card (Figure 2) is divided into four sections, the first three being used for recording information, the last three for punching. The written information in the first section of the card is punched in the second section, beginning at column 20. The written information is always visible to the key-punch operator, to the left of the columns to be punched. The punching zones fall between the spaces for the written material so that the card may serve as a permanent record of morbidity absence, as well as being used for direct machine punching and tabulation.

In addition to the employee's name and the name of the company, which are recorded at the top of the card, space is provided for the recording and punching of information in 19 fields. These include plant number, industry, employee's identification number, age, sex, marital status, department, occupation, date absence began, date absence ended, days absent (both calendar and working days), time group, termination, order of illness, diagnosis I and diagnosis II, class (whether occupational or non-occupational), by whom diagnosed, and type of card (to indicate carry-over of days lost into succeeding recording period).

This dual-purpose card is thus designed to collect the same information as is collected with the margina punch card, except for times absent. Additional information, however, may be collected on the dual-purpose card, if desired, under the headings plant number, industry, employee's identification number, calendar days absent, time group, diagnosis II, by whom diagnosed, and type of card.

Collection of Data

The same general procedure applies in collecting information with the dual-purpose card as was described for the marginal punch card. At the time the dual-purpose card is initiated, information pertaining to fields A to I is entered on the card and the remaining fields are completed upon termination of the absence. Absences still unterminated one month after the end of the recording year are closed off as described for the marginal punch card.

Recording and Coding of Data

Plant number, field A (up to two digits) will be the code number allotted to that plant by the company. This serves to identify plants within the company. Where there is only one plant, no entry is required, and the code number "00" will be punched. Industry, field B, is indicated by a code number (up to three digits) allotted to that industry. It is suggested, tentatively, that industry code numbers be assigned by the division of industrial hygiene. Field C is reserved for the employee's identification number. If a payroll number or clock number is assigned to each employee at the plant, such a number (up to five digits) may be used to identify each employee's absence record cards. Where employee identification numbers do not exist, it will be necessary for the company to allot identification numbers to all employees. Information pertaining

to fields D to J, inclusive, is entered and coded as described for the marginal punch card.

Both the number of calendar days absent and the number of working days absent are to be recorded. The counting of working days presents difficulties where the routine is not regular, as in broken shifts, etc., but it does permit a computation of the proportion of total working time which was lost due to disease or injury, and also allows for the days lost to be computed as a monetary loss.

The time groups, for both working and calendar days, should be the same as the duration groups described for the marginal punch card.

The use of field R, diagnosed by, is self-evident. Field S, type of card, is used to designate completed absences and those which are not terminated at the end of the year. This provision has been made in case it is desired to count only absences and days lost within the recording year, rather than absences occuring within the recording year and the days lost by those absences, some of which will carry over into the succeeding year. The final diagnosis is to be entered in field O. Provision is also made on the card for the recording of an additional diagnosis in field P. This field may be used for the recording of complicating diseases or for special studies which are not ordinarily correlated with lost time.

A short morbidity classification for use in industry, based on the international statistical classification, has been prepared. This list covers 16 of the 17 sections of the international classification and contains two additional sub-divisions. The headings for the short classification are the same as the 18 diagnosis groups listed above, although not in the same order. These eighteen headings contain 72 independent rubrics, and

these latter cover the complete range of the international classification while providing specifically for those causes of particular interest or frequency in the field of industrial morbidity.

The complete list, with the related international statistical classification numbers, is presented in appendix B. Numbers to be used for coding and punching are given in the first column. These code numbers are entered in field O, diagnosis I, of the dual-purpose card, together with the written detailed diagnoses. The fineness in coding diagnoses depends upon the desired volume of data, and expansion or contraction of this classification is optional. Where, for special purposes, it is desired to record additional diagnoses, as for accidents or symptomatology, the full list of three-digit categories of the international statistical classification should be used. These code numbers may be entered in field P—diagnosis II.

THE HAND TABULATION METHOD

The basic record in the hand tabulation method is an individual industrial morbidity record card measuring 5" by 8" (Figure 3). Space is provided for the recording of the employee's name, age, sex, department, occupation, division (whether the absence was due to sickness or accident), class (occupational or non-occupational), date absence began, date absence ended, the working days lost and the diagnosis. Information dealing with ten morbidity absences may be entered on the front of the card and a similar number on the back.

NAME _____ AGE _____ SEX _____

DEPARTMENT (1) _____ (2) _____ OCCUPATION (1) _____ (2) _____

ABS. No.	SICKNESS NON-OCC.	SICKNESS OCC.	ACCIDENT NON-OCC.	ACCIDENT OCC.	ABSENCE BEGAN	ABSENCE ENDED	WORKING DAYS LOST	DIAGNOSIS
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

G. & T. LTD. H.Y. 1931 INDUSTRIAL MORBIDITY CARD No. III DEPARTMENT OF HEALTH FOR ONTARIO

FIGURE 3

Collection of Data

The procedure in collecting information to record on this card is much the same as for the marginal and dual purpose punch cards. When a change occurs in an occupation or department during a year, the absence numbers relating to the first department or occupation should be noted in brackets beside the appropriate

heading and the new department or occupation entered on the second line provided.

One month after the end of the recording year the working days lost by all absences still unterminated are estimated and entered on the cards. When the cards have been completed for all employees who were absent because of sickness or accident in a given year they are sorted by sex and counted. The number of cards represents the number of persons absent and these figures are posted to work sheets, one for males and one for females.

Each work sheet consists of nine vertical fields, each subdivided into two columns of 50 rectangles each. These fields provide for the summarizing of data on non-occupational sickness of 1 to 3 days, 4 to 7 days and 8 days duration or more; occupational sickness of less than 8 days and of 8 days duration or more; non-occupational accident of less than 8 days and of 8 days duration or more, and occupational accident of less than 8 days and of 8 days duration or more. The "working days lost" are transferred from the record cards to these fields, each entry thus indicating an absence. Care must be taken to post the absences in the correct vertical field of the work sheet.

When the information on all the record cards has been transferred, the days lost are added for each pair of vertical columns of the work sheets and these figures are entered in the horizontal "days lost" row below the nine fields. The number of rectangles with entries will represent the number of absences within each field heading and these numbers are entered in the horizontal "absences" row below the fields. The horizontal "days lost" and "absences" rows are each summed up at the bottom of the sheet.

PLANT POPULATION DATA

For the preparation of rates it is necessary to prepare plant population tables based upon only those employees who are required to report morbidity absences to the plant medical department. It is essential that these tables show a breakdown of the population by sex, and it is desirable with either punch card system that they include breakdowns by age group and by prearranged department groups. If any special occupational hazards are to be studied, payroll strength figures by occupation should also be secured to permit the computation of morbidity rates by occupational group. Population tables should be prepared at the end of each quarter year, or more often if possible, and the average figures derived from these tables used to compute the annual rates.

ANNUAL STATISTICAL SUMMARIES

From the data recorded, it is possible to prepare a useful and complete statistical summary for use by the plant medical department and management, and to tabulate rates for comparative purposes. Four morbidity indices are defined for use in the preparation of statistical summaries of lost-time morbidity and their general adoption by industry is recommended in the interests of uniformity.

Index I, Frequency rate—annual number of absences per 100 employees

Index II, Disability rate—annual number of days lost per employee

Index, III, Severity rate—average number of days lost per absence

Index, IV, Non-effective rate—average daily percentage of workers disabled.

The Marginal Punch System

For the compilation of comparable statistics dealing with the causes of morbidity absence, it is necessary to group the diagnoses. Tables are prepared which present absences and days lost by sex, relating to the 18 diagnosis groups referred to above in collection of data for the marginal punch system. From these 18 groups it is readily possible to reconstruct the 16 headings of the international classification which apply to adult population.

In small plants and for general comparative purposes, a condensed grouping of diagnoses under 7 headings is desirable. The following headings, which are referred to as the condensed diagnosis groups, are those of particular interest or frequency to industry.

1. Acute upper respiratory infections
2. Other diseases of the respiratory system
3. Diseases of the digestive system
4. Disorders of menstruation
5. Symptoms and ill-defined conditions
6. Accidents, poisonings and violence
7. Other specified causes.

The first six condensed diagnosis groups are the same as the first six of the 18 diagnosis groups. The seventh condensed group is the sum of headings 8 to 19 of the diagnosis groups.

As has been explained in appendix A, data on occupational and non-occupational sickness and accident are not readily obtained by use of the codes in the manual of the international classification. However, a coding and sorting technique has been defined in the brochure to provide for the tabling of absences and days lost by sex under the following headings: (1) non-occupational sickness, (2) occupational sickness, (3) non-occupational accident, (4) occupational accident. This grouping of the causes of absence is known as a class-division.

The company may prepare tables of any combination of headings on the card, as desired, but it is suggested that certain tabulations be made routinely as an aid to uniformity. The eight tables listed below will afford the essential data.

1. Population summary by age group and sex
2. Absences and days lost by age group and sex
3. Absences and days lost by times absent and sex

4. Duration of absence in working days by sex
5. Absences and days lost by department group and sex
6. Absences and days lost by diagnosis group and sex
7. Absences and days lost by condensed diagnosis group and sex
8. Absences and days lost by class-division and sex

From the absolute data presented in the above tables, the four indices of morbidtiy should be prepared in tabular form for the material in tables 2, 5, 6, 7 and 8.

The Dual-Purpose System

It is apparent that the proposed method of coding for this system provides for the recording and tabulating of diagnoses to as fine a degree as the plant physician may wish, within limits of the three-digit categories listed in the manual. But since some condensation is essential, it is suggested that the short morbidity classification be followed, and the short list numbers be used for its 72 items.

For comparative purposes, data in the form of the 18 diagnosis groups should be presented. These are readily obtained as they comprise the headings within the short morbidity classification. The seven condensed diagnosis groups described above may also be prepared. Data for presentation by class-division may be obtained as explained in the dual-purpose card brochure.

Seven of the eight essential tables referred to above, together with the suggested tables of morbidity indices, may be prepared as annual summaries. Data for the table on times absent are not collected in the dual purpose system. This system, however, provides for the tabling of calendar days lost as well as working days and for the preparation of additional multiple tables.

The Hand Tabulation System

Data on sicknesses and accidents of occupational or non-occupational origin are obtained from this system. Thus, the four morbidity indices may be prepared by class-division and sex. In addition, this information may be divided between absences of less than 8 days, and absences of 8 days and over. The average population by sex, together with data from the cards, may be presented annually in the following tables:

1. Summary of staff and morbidity data by sex
2. Absences and days lost by sex, by division, class and duration
3. Absences and days lost due to sickness by sex, class and duration
4. Absences and days lost due to accident by sex, class and duration.

CONCLUSION

From the above outline it is apparent that two of the recording systems provide for the collection of lost-time morbidity data, by sex, under 18 diagnosis groups —these groups being essentially similar to the section headings of the international classification. In addition, all three systems of recording provide for the collection of the data by sex and class-division (i.e., non-occupational sickness, occupational sickness, non-occupational accident and occupational accident). It is suggested that collected data be compared in the form of the four morbidity indices described.

Figures on lost-time morbidity which were collected in two plants using the marginal-punch card system have been analyzed; attention is drawn to the value of comparing such experience, as presented in Vol. 42 No. 10, *Canadian Journal of Public Health,* October, 1951.

A further need in the field of industrial morbidity reporting is a system of recording non-absence visits to the plant medical centre, which will allow reported conditions to be collected under the headings of the international classification. Tabulation sheets for this purpose have been designed and a brochure prepared describing their use. Thus, conditions reported to the medical centre may be summed up under the 18 diagnosis groups (plus 8 injury sub-headings of the manual). The adoption by industry of uniform classifications and methods for collecting and tabulating all morbidity will enable comparison to be made within a company of their lost-time experience and conditions reported to their medical centre, as well as permitting the compilation of morbidity statistics for general comparison within industry as a whole.

APPENDIX A

INTERPRETATION OF TERMS USED

1. *Absence* — The loss of time from work, from any cause of morbidity, of one full day or more, unless the duration is otherwise specified.

2. *Disease*	Those causes of morbidity constituting the first 16 sections of the international classification (code numbers 001-795).
3. *Injury*	A condition produced by an external cause such as violence, accident, poisoning or misadventure in applying a diagnostic procedure. Injuries constitute section 17 of the international classification (code numbers 800-999).
4. *Sickness*	Those causes of morbidity constituting the first 16 sections of the international classification, plus non-accidental injuries, i.e. effects of poisons, weather, exposure and related conditions (code numbers 001-795 plus 960-989).
5. *Accident**	Those causes of morbidity constituting section 17 of the international classification with the exception of effects of poisons, weather, exposure and related conditions (code numbers 800-959 plus 990-999).
6. *Division*	This term refers to whether the cause of morbidity is sickness or accident in origin, as interpreted above.
7. *Class*	This term refers to whether the cause of morbidity is occupational or non-occupational in origin, as interpreted below.
8. *Class-division*	Is a breakdown of industrial morbidity data under four headings: (1) non-occupational sickness, (2) occupational sickness, (3) non-occupational accident, (4) occupational accident.
9. *Occupational*	(a) *Occupational sickness* is a sickness as defined above, resulting from a specific hazard or condition of the environment encountered at the place of work. (b) *Occupational accident* is considered to be a sudden, unforeseen event resulting in traumatic injury from mechanical, thermal or electrical causes occurring to a gainfully employed person while at work. For inclusions, see under "accident", above.
10. *Non-occupational*	Non-occupational sicknesses and accidents refer to those sicknesses and accidents as defined above which are not associated with either an occupational hazard or harmful environment condition, or occurrence at place of work.

*In conformity with the international statistical classification, abdominal hernia is considered a disease or sickness entity.

SHORT LIST NUMBER	INTERNATIONAL CLASSIFICATION NUMBERS	SHORT MORBIDITY CLASSIFICATION TITLE
010	001-138	*Infective and Parasitic Diseases*
011	001-008	Tuberculosis of respiratory system
012	010-019	Tuberculosis, other forms
013	020-029	Syphilis and its sequelae
014	030-035	Gonococcal infection
015	045-048	Dysentery, all forms
016	050-055 056-085,089	Common infectious diseases (scarlet fever, diphtheria, whooping cough, measles and mumps)
019	Rest	Other infective and parasitic diseases
020	140-239	*Neoplasms*
021	140-205	Malignant neoplasms
022	210-229	Benign neoplasms
029	230-239	Neoplasms, not otherwise specified

030	240-289	*Allergic, Endocrine, Metabolic and Nutritional Diseases*
031	240-245	Allergic disorders
032	250-254	Diseases of the thyroid gland
033	260	Diabetes mellitus
039	270-289	Other metabolic, endocrine and nutritional diseases
040	290-299	*Diseases of the Blood and Blood-Forming Organs*
041	290-293	Anaemias
049	294-299	Other diseases of the blood and blood-forming organs
050	300-326	*Mental, Psychoneurotic and Personality Disorders*
051	300-309	Psychoses
052	310-318	Psychoneurotic disorders
059	320-326	Disorders of character, behavior and intelligence
060	330-398	*Diseases of the Nervous System and Sense Organs*
061	330-357	Diseases of the nerves and peripheral ganglia
062	360-369	Other diseases of the nervous system
063	370-389	Diseases of the eye
069	390-398	Diseases of the ear and mastoid process
070	400-468	*Diseases of the Circulatory System*
071	400-402	Rheumatic fever and chorea
072	410-416	Chronic rheumatic heart disease
073	420-422	Arteriosclerotic and degenerative heart disease
074	440-447	Hypertensive disease
075	450-456	Diseases of the arteries
076	460-466	Diseases of the veins
079	Rest	Other diseases of the circulatory system
080	470-475	*Acute Upper Respiratory Infections*
081	470	Acute nasopharyngitis (coryza)
082	471	Acute sinusitis
083	472-474	Acute tonsillitis, pharyngitis, laryngitis and tracheitis
084	475-481pt	Acute upper respiratory infection of multiple or unspecified sites (include "flu", grippe, influenza with upper respiratory infection)
08X	480-527	*Other Diseases of the Respiratory System*
085	480-481pt & 482-3	Influenza
086	490-493	Pneumonia
087	500-502	Bronchitis
088	519	Pleurisy
089	Rest	All other respiratory diseases
090	530-587	*Diseases of the Digestive System*
091	530-535	Diseases of the teeth and supporting structures
092	540-545	Diseases of the stomach and duodenum (except cancer)
093	550-553	Appendicitis
094	560-561	Hernia of abdominal cavity
095	571	Gastro-enteritis and colitis
096	584-586	Diseases of gall bladder and bile ducts
099	Rest	Other diseases of digestive system
100	634	*Disorders of Menstruation*
10X	590-637	*Other Diseases of the Genito-Urinary System (except 634)*
101	590-594	Nephritis and nephrosis
102	600-609	Other diseases of urinary system
109	610-637	Other diseases of genital organs

110	640-689	*Deliveries and Complications of Pregnancy and Childbirth*
120	690-716	*Diseases of the Skin and Cellular Tissue*
121	690-698	Boils, cellulitis, abscesses and other skin infections
129	700-716	Other diseases of skin and subcutaneous tissue
130	720-749	*Diseases of the Bones and Organs of Movement*
131	720-727	Arthritis and rheumatism, except rheumatic fever
130	730-749	Other diseases of the bones and organs of movement
140	750-759	*Congenital Malformations*
160	780-795	*Symptoms and Ill-Defined Conditions*
161	791	Headache
162	790	Nervousness, debility and asthenia
160	Rest	Other symptoms and ill-defined conditions
170	800-999	*Accidents, Poisonings and Violence*
171	800-829	Fractures
172	830-839	Dislocations without fractures
173	840-848	Sprains, strains of joints and adjacent muscles
174	850-856	Head injury (excluding fracture of skull)
175	860-869	Internal injury of chest, abdomen and pelvis
176	870-908	Lacerations and open wounds
177	910-929	Superficial injury, abrasions, contusions
178	930-936	Foreign body entering natural orifice
181	940-949	Burns
182	950-959	Injury to nerves and spinal cord
183	960-979	Effects of poisons
184	980-989	Effects of weather, exposure and related conditions
189	990-999	Other and unspecified accidents

On the cover, a technician of the radiology laboratory of the National Research Council is shown inspecting a radiograph of a bronze valve. The radiograph, taken by means of the penetrating gamma rays from radioactive iridium-192, reveals the internal structure of the valve making possible detection of internal flaws. (Photo by Capital Press Service, Ottawa)

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